WORKING COLLECTIVELY TO DESIGN ONLINE TEACHER EDUCATION CURRICULUM: HOW DO TEACHER EDUCATORS MANAGE TO DO IT?

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This paper is part of a three-year inquiry that supports and investigates the work of groups of mathematics teacher educators using technological tools to design and implement multimedia practice-based teacher education curriculum materials. This paper describes the kinds of activities, interactions, and tools used by mathematics teacher educators to engage in such work. Using Engeström's Activity Theory as a framework, we organize our observations of the groups' work sessions, noting differences across the groups' objectives and ways of organizing the division of labor and tools for engaging in the work. Our results suggest the activity of collective curriculum development amongst teacher educators can take on at least three distinct types of interactions. We present these types of interactions as "caricatures" (Lambdin & Preston, 1995), using data from all of the groups to represent composite descriptions.

Keywords: Curriculum, Instructional Activities and Practices, Teacher Education-Preservice, Teacher Education-Inservice/Professional Development, Technology

Introduction

We share data from an ongoing NSF project that engages groups of mathematics teacher educators in collective work using technological tools to design and implement online practice-based teacher education curriculum materials. The work within that project can be broadly framed as part of the larger efforts to reimagine mathematics teacher education through the development of a common curriculum (Ball and Forzani, 2011) centered on practice-based experiences for enabling novices to learn to teach *in, from*, and *for* practice (Lampert, 2010). The efforts to reimagine mathematics teacher education may tread some of the same terrain as the well-studied efforts to reform K-12 mathematics through the design of better curriculum (e.g. Lappan & Phillips, 2009) and professional development for supporting teachers to use those materials (Remillard, Herbel-Eisenmann, & Lloyd, 2009). Both efforts attempt to address deficiencies in the current systems by reimagining, in some measure, what happens in instructional settings (whether in K-12 or higher education); and both treat curriculum as a lever to do that.

To understand how teacher educators may use the curriculum of teacher education to make teacher education practice-based, it is useful to consider the different ways in which teachers use curriculum in K-12 settings: While there is a tradition in which curriculum developers create materials, teach them to teachers, and then teachers implement them with fidelity as a goal, that is by no means the only use. Reviewing the literature of curriculum use studies, Remillard (2005) describes three kinds curriculum use studies and their corresponding perspectives. The first set of studies takes the perspective of curriculum as a "fixed entity" and takes for granted that the teacher serves as a "conduit for the curriculum". The second set of studies takes the perspective of the curriculum as a more or less stable starting point from to which the teacher makes adaptations in ways that may be more or less faithful to the curriculum design. The third set of studies takes the perspective that the teacher is positioned as an active interpreter of the written curriculum and "author" of the enacted curriculum (Doyle,1992). Ball and Cohen (1996) suggests a reconceptualization of curriculum as a site first for teacher learning and then a resource for student learning. This suggestion fits well into this third perspective as such an approach gives teachers an

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opportunity to work collaboratively with curricula materials in order to decide how they will use them to solve the problems of improvement.

In this paper, we aim to describe and explain how groups of teacher educators organize their collective work around the task of designing and implementing technology-mediated practice-based curricular materials for teacher education. Research on curriculum use suggests that there could be a host of ways that the field addresses the larger problems of developing common practice-based curricular materials for teacher education; and each of these approaches comes with different kinds of affordances and constraints for the work at hand. We wonder about the various ways in which mathematics teacher educators might elect to organize themselves around the task of developing technology-mediated practice-based teacher education materials and what sort of affordances and constraints can be found across the variety of organizational choices. In this paper, we describe and explain three ways in which 12 groups of mathematics teacher educators engaged in the activity of collectively developing and using technology-mediated practice-based materials for teacher education. To do this, we use methods from activity theory, noting differences across the groups' objectives, division of labor, and tool usage. To illustrate these differences, we borrow a practice from Lambdin and Preston (1995, p. 130) and create "caricatures" of groups to describe these differences, where a caricature represents a composite description by combining information from all 12 groups.

Methods

Setting

In this paper, we present our findings regarding the types of interactions between 12 Fellows and their Inquiry Group Members (IGMs) across a two-and-a-half year timeframe from May, 2014 to November, 2016. The Fellows come from research institutions (Doctoral institutions with the moderate, higher, and highest levels of research activity) and serve in a variety of positions (Assistant, Associate Professor, and Full Professor as well as Lecturers). Next, each Fellow formed their own inquiry group that included one to seven members from a variety of institutions and geographic locations. The Fellows assembled inquiry groups for the purposes of developing technology-mediated mathematics teacher education curriculum materials.

To develop these materials, the Fellows and their Inquiry Group Members had access to the tools and capabilities within the Lesson*Sketch* platform (www.lessonsketch.org). Lesson*Sketch* provides teacher educators with a suite of online tools for composing and interacting with multimedia representations of practice. ***Depict*** offers users a drag-and-drop environment allowing users to easily represent scenes from a classroom in the form of a storyboard. ***Annotate*** allows users to make time-stamped comments on a variety of media files, such as video, audio, or storyboards. ***Plan*** offers users a drag-and-drop environment for authoring agendas for interactive experiences for clients, integrating multimedia tools for both producing and interacting with representations of practice with more traditional course planning tools such as multiple choice and open-ended question generators. In addition to those tools, Lesson*Sketch* also has accompanying capabilities for enabling users to manage and study client interactions with the experiences. One such capability is the ***Experience Manager*** that allows users to distribute online experiences to clients by either assigning the experience directly to clients in Lesson*Sketch* or by providing them with an access code or an email link. The second capability, ***Reports,*** allows users to collect data about clients' activities within such experiences, including both user contributions (such as responses to questions or pins on a video) and behaviors (such as time spent on an activity).

For the first year of the project, the Fellows worked on drafting an instructional module(s) for one of their own courses. The Fellows' modules (like the Fellows' teaching assignments) were

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varied, with some designed for pure mathematics coursework, others for mathematics methods coursework, and still others for general education coursework. During the first year, the Fellows met together with the project group for two face-to-face meetings and participated in monthly online meetings across the year to check in with one another. During the second year of the project, the Fellows recruited Inquiry Group Members to help implement and/or construct modules. During this time the Inquiry Group Members met together with their Fellow and with the project team for face-to-face for work sessions on three occasions and held their own meetings throughout the year (either virtually or face-to-face on their own schedule). The Fellows continued to meet virtually, with one another, every month.

Data Collection

We collected a variety of data to document the ways inquiry groups organized themselves to collectively develop and/or enact curricular materials. For this research, we documented each group's work in several ways. During the year one face-to-face meetings, we observed the Fellows' interactions with one another and the project staff, collecting audio recordings of whole group discussions and taking field notes during their work sessions. During the year two face-to-face meetings, we observed the Fellow's interactions with the Inquiry Group Members and with project staff, taking field notes about the ideas exchanged and the roles various group members were taking on. Across both years, we conducted and recorded monthly interviews with Fellows using video conferencing software, to support their progress. In the Fall of 2016, we surveyed Inquiry Group Members using adapted versions of the Concerns Based Adoption Model (George, Hall, & Stiegelbauer, 2006) and Team Climate (Anderson & West, 1998) Surveys. We used this survey to investigate the group distinctions as well as some of our observations about differences in possible group characteristics (state of the modules when the IGM joined the group, agency, similarity of professional goals) more thoroughly. We used Inquiry Group Members' responses to the survey to verify the nature of each group's activity (e.g., whether or not the primary activity and ways of working—*implementation, collective construction,* or *independent construction*—we had observed were compatible with the primary activity and ways of working the group members identified) as well as to confirm some key characteristics that were difficult to fully perceive from observation alone. Lastly, we collected system-use data to understand whether and how different groups used the various tools and capabilities within the Lesson*Sketch* platform.

Data Analysis

To begin describing the inquiry group interactions in a systematic way, we analyzed the data using Engeström's (1987) activity theory, and its related mediational triangle (Figure 1). Activity theory was developed to model goal- (or object-) oriented behavior as activity systems, accounting for the collective nature of human activities as interactions between distinct elements.

While all the inquiry groups could be described as comprising the same type of *subjects* (mathematics teacher educators) working on behalf of the same type of *community* (fellow mathematics teacher educators) for the same *outcome* (namely educating future or current mathematics teachers), our observations of their activities suggested several important differences across groups within the *object*, *division of labor*, *rules*, and *tool* components of the mediational triangle. First, we noticed differences in "what" the inquiry groups were collectively focused on doing together, that is a difference in the groups' *objects (or goals)*. Avowedly what they all had to do related to an instructional module. Groups seemed to primarily be focused either on constructing modules (either collectively or individually) or implementing a module created by the Fellow or some other group member. Based on these differences, we categorized the groups' activity systems according to one of two objects: *construction* or *implementation.*

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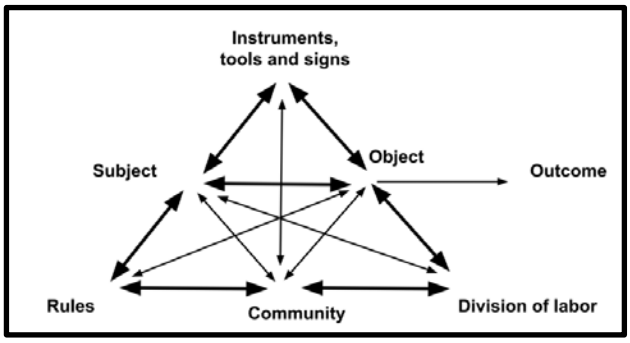

Figure 1. Engeström's mediational triangle (Engeström, 1987)**.**

Second, while all of the groups with an *implementation* objective seemed to use the same *division of labor*, namely the Fellow played the role of "curriculum writer" while the Inquiry Group Members implemented that curriculum in their own settings, we noticed differences in how those groups with *construction* objectives divided the labor. Some of those groups took on the task of constructing a module(s) in such as way that the Fellow and the Inquiry Group Members worked together to develop a single set of materials; other groups took on the work so that the Fellow played the role of "lead innovator"—developing his or her materials first—and the Inquiry Group Members each followed suit by patterning their own materials after the Fellow's work, but not necessarily in ways that would allow for the materials to be implemented together. Based on these differences in the *division of labor* we categorized the construction groups into two different types: *collective construction* or *independent construction*.

Third, we noticed some important broad similarities in the ways the tools mediated the work of the Fellows and Inquiry Group Members. To begin, the ***Depict***, ***Annotate,*** and ***Plan*** tools were primarily used for their authoring capabilities. While the ***Plan*** tool was created for authoring experiences, there are many other ways in which ***Depict*** and ***Annotate*** could be used. While the ***Depict*** tool can be used to author content for experiences (e.g., develop storyboards for students to interact with), it can also be used to provide feedback to students' contributions (e.g., to provide a visual interpretation of a student's vague narrative account of a classroom event and ask whether it happened in that way). Similarly, while the ***Annotate*** tool can be used to author content for experiences (e.g., identify moments of a video for students to comment on), it can also be used to provide feedback to students about their contributions within an experience. For the most part, however, we observed the Fellows and their Inquiry Group Members using ***Depict*** and ***Annotate*** to *author module content*. Thus, for the purposes of this work, we classified the use of ***Depict***, ***Annotate,*** and ***Plan*** as mediating primarily the authoring of modules; while the capabilities within ***Experience Manager*** mediating the *distribution of modules for review* prior to implementation as well as *distribution of modules for implementation* with students; and the capabilities of ***Report*** for *analyzing aspects of the module use*.

Finally we noticed some important differences across groups in terms of the ways in which they used the different capabilities (*Authoring* Modules, *Review* and *Distribution* Modules for Implementation*,* and *Analyzing* Module Use*)* in the Lesson*Sketch* system to mediate their collective work. We suspected that there would be meaningful differences in the ways in which these groups used the tools and capabilities to mediate their collective work, but since much of their tool usage happened when we were not directly observing them we could not be certain which tools and capabilities they were accessing without a closer examination of system data.

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Results and Discussion

In this section, we present our overall findings by developing caricatures or composites of the Inquiry Groups' work based on their group structure, the conditions that seemed to characterize the group's activity system, and the ways in which the tools and capabilities afforded by the Lesson*Sketch* platform seemed to mediate that activity. By taking the inquiry group to represent the unit of analysis, we emphasize that the caricatures do not reflect the work of individuals but the larger activity system. The caricatures were created during the data analysis process as opposed to being a priori to the analysis.

The categorization of the groups or subgroups as engaged in *implementation, collective construction,* or *independent construction* activities came fairly easily from the observations as described above. Our observations were confirmed in the survey responses from the Inquiry Group Members. Those working in *implementation* groups describing their work primarily in terms of *using*, *piloting*, or *suggesting revisions* to the module created by the Fellow and those in the *construction* groups describing their work primarily in terms of *building*, *designing*, or *creating* module(s). Inquiry Group Members engaged in *independent construction* activities indicated relatively more concern about the personal consequences of the project including logistics and the time involved in the activities of the project than those engaged in *collective construction* activities. To represent these composites in more memorable ways, we use the metaphor of different ways of having a dinner party: (1) Hosting; (2) Potluck; (3) Cooking Club.

Hosting. One way to organize a dinner party is for the host to prepare a single meal for the guests. While customs may differ, this kind of organization usually calls for the bulk of the meal preparation to take place prior to guests' arrival. Similarly, those groups with an *implementation* objective commenced after the Fellow had drafted a version of the module that was ready for distribution and the primary focus of the group was to implement a common set of teacher education modules. These groups tended to be large (~5 members) and the members held similar professional goals, usually in the form of a common course or a common approach to teacher education. Coming back to the metaphor of a host preparing a meal for guests, the host needs to consider ahead of time the match between the dish prepared and the kinds of foods the guests are accustomed to eating. The host could ensure this match by preparing a dish common enough to be palatable to all of the guests or by selecting guests amenable to the kind of dish that will be served. We see evidence of the Fellows in these groups using both strategies, both designing the module around common themes in the field as well as identifying Inquiry Group Members according to similar perspectives on teacher education. Once these groups gathered, their activities were highly structured, with the Fellow providing the module, the Inquiry Group Members enacting it with their students and providing data back to the group to inform the Fellow's revision of the module. These clearly defined roles seemed to come with fairly hierarchical structures that positioned the Inquiry Group Members to enact the module without revisions, as to provide the cleanest data back to the Fellow. While some exceptions were made, these negotiations happened privately between the Fellow and the individual Inquiry Group Member. This kind of hierarchical structure guiding the *division of labor* is somewhat unsurprising if one considers the metaphor of a host preparing a single meal for many guests. Modifications to the meal just prior to the serving could be quite difficult for a host to accommodate and such modifications could jeopardize the more primary activities of the evening, such as sharing a meal together or gathering feedback about a dish. The kinds of comments Inquiry Group Members made following implementation of a module were summative—focused tweaking small elements of the module. Again, in light of the metaphor, this is perhaps unsurprising given the kinds of access guests at a dinner party have to the actual production of the meal. The structure of this type of Group could be observed in the use of the technological tools, the Fellows in these groups (compared with Fellows from the other two groups), were the heaviest users of the *review, distribution,* and *analysis*

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tools; while their Inquiry Group Members (compared with Inquiry Group Members from the other two composites), tended not to use many tools.

Potluck. A second way to organize a dinner party is for everyone to bring a single dish to share with others at the host's home and collectively the individual contributions make up the meal, sometimes called a potluck. Those groups engaged in an *independent construction* activity, commenced after the Fellow had drafted a version of the module and the focus of these groups' activity was on both providing feedback on the Fellow's modules and using the Fellow's module as inspiration for each member to make their own. These groups also tended to be large (~5 members) and its members held different professional goals; some joining because the work might offer research opportunities while other members joining to learn how to use technology to construct materials for their own courses. Like the *Potluck* model for dinner parties, these groups handled their collective work by dividing and conquering, with members carrying out their roles in fairly disconnected ways, working parallel to or in tandem to one another's efforts sometimes unaware of the various work of other members. Unlike the *Hosting* model for organizing dinner parties, *Potluck* models do not require a host to ensure that the prepared dishes match the kind of foods guests might be interested in consuming. For one, a guest's own dish can provide some assurance for such a match, but also the wide variety of dishes to choose from ensures that guests will find something they are amenable to eating. Similarly, the Fellows in these groups were not observed needing to make any sort of accommodations or negotiations regarding implementation of modules, nor did the group make any sort of official bid that any materials would be implemented, leaving it mostly up to the Inquiry Group Members to decide what, if anything, they would like to try out in their own contexts. That said, like the participants at a potluck who sometimes seek out recipes for particular dishes brought by guests, Inquiry Group Members' knowledge was seen to be a resource for offering ideas for their own module and revisions for the Fellow's module. Both the Fellows and their Inquiry Group Members were the heaviest users of the authoring capabilities (when compared with their counterparts across the other two groups).

Cooking Club. A third way to organize a dinner party is for guests and host to plan and cook a meal together as with cooking clubs or progressive dinners. Distinct from the *Hosting* or *Potluck* models for organizing a dinner party, the *Cooking Club* model for dinner party organization does not require for the bulk of meal preparation to happen prior to commencing the activity. Instead, the host takes on the responsibility to send invitations or perhaps make provisions for supplies for the meal; and the guests for such events arrive with anticipation for taking part in the cooking. Similarly, groups engaged in *collective construction* activities commenced at a time when the module was still in the form of a vision and not yet drafted in any concrete way and the primary focus of the group was to create a common set of teacher education modules. These groups tended to be smaller (1 to 3 members) and members held similar professional goals usually in the form of a common course or a common approach to teacher education. Unlike the *Hosting* model for organizing dinner parties, *Cooking Club* models do not place exclusive responsibility on the host for ensuring that the prepared meal matches the kind of foods guests might be interested in consuming, because the decision on the meal to be prepared is shared by the group. Similarly, the Fellows in these groups were not observed needing to make any sort of accommodations or negotiations regarding the eventual implementation of the collectively developed module. Perhaps like a *Cooking Club* that has been gathering for some time, these groups' exchanges were characterized by an insider language, where group members seemed to have a shared understanding for the meaning and value of particular constructs (making it sometimes difficult for an outsider, such as the researchers, to follow the conversations). This way of using language seemed to, at least in some ways, make the Inquiry Group Members' knowledge readily accessible for use by the group to design and revise the materials. The activity of *collectively constructing* modules seemed to promote the sharing of practical knowledge within these groups that

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would often times move fluidly between bursts of creation followed by more theoretical conversations. We liken this kind of sharing of knowledge through collective action to the gathering of individuals around a counter to collectively dice a meal's ingredients and who may learn simply by carrying out the practice of dicing near others who are also dicing, but might also stop to clarify the distinctions between the practices of chopping, dicing, and mincing. The Fellows in these groups, while not the highest users in any of the categories of *authoring*, *reviewing, distributing*, or *analyzing*, these Fellows maintain fairly high uses across all capabilities; while their Inquiry Group Members were the only frequent users of the *reviewing* capabilities (compared with Inquiry Group Members from the other two composites), they were also users of all capabilities.

Significance of the Research

In the above findings, we presented three different caricatures representing the ways in which we observed teacher educators organize themselves around the activity of constructing mathematics teacher education curriculum materials. In the presentation of these three caricatures, we see two important differences between the larger body of literature on curriculum use and this work. The first difference stems from the fact that these groups were designing digital materials that can be easily edited which is distinct from the more canonical use of curriculum in which materials are less amenable to such edits. Related to this difference, we take as critical the finding regarding the ways in which the digital tools seemed to mediate various kinds of activities related to the design and use of online curriculum material. The second difference stems from the fact that these groups were comprised of teacher educators, rather than K-12 teachers. Distinct from K-12 curriculum use, we note that the "status" of curricular materials in this project is far from "fixed". The mathematics teacher educators featured worked closely (or perhaps they were themselves) with curriculum writers. Related to this difference, we take as critical the finding that teacher educators not officially "charged" with the writing of the materials (as was the case for the Inquiry Group Members) can be positioned in very different ways within the work of developing and implementing curricular materials for teacher education. Perhaps most importantly, we see this work as laying the groundwork to begin asking questions about what each of these various models of activity affords to the work of designing and implementing teacher education with digital curricular materials.

Endnote

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